

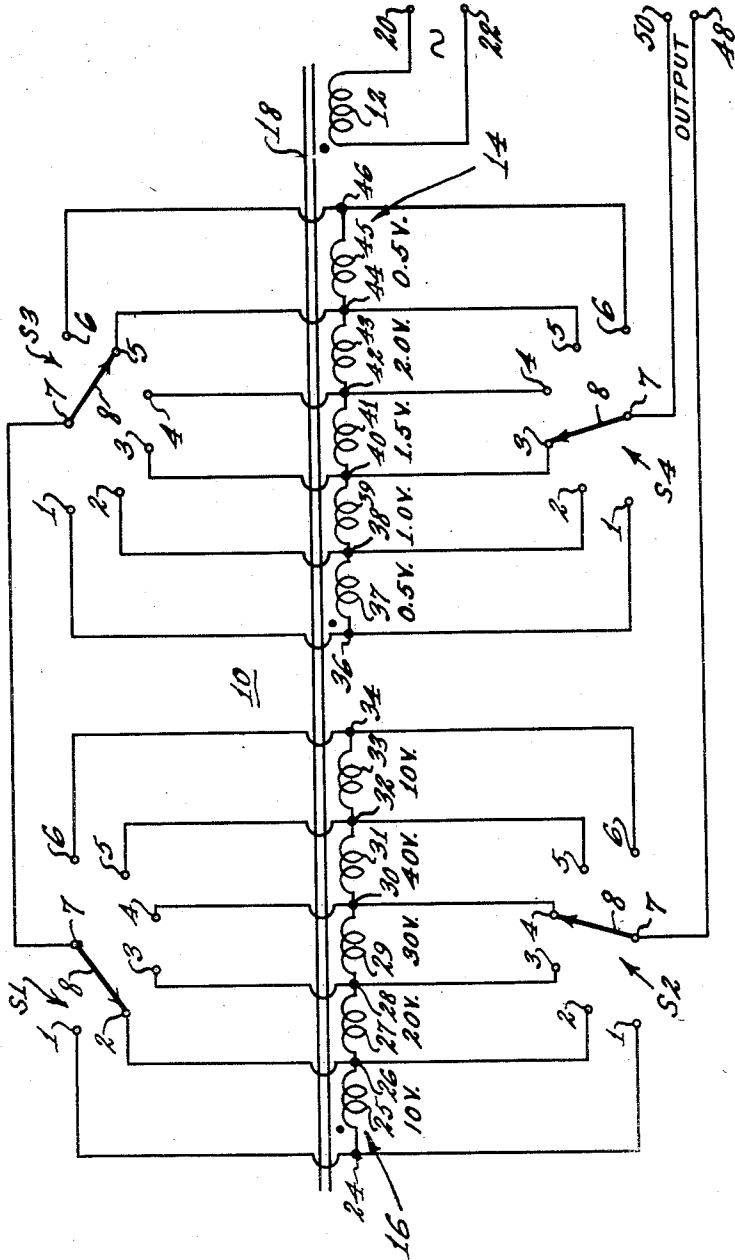
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VARIABLE VOLTAGE SWITCHING DEVICE

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VARIABLE VOLTAGE SWITCHING DEVICE

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This invention relates to means for selecting a desired output voltage from among a plurality of available voltages, and more particularly to a variable voltage switching device adapted to add and subtract voltages selectively. The variable voltage switching device of the present invention is particularly useful in electronic apparatus, such as a tube tester, wherein a plurality of voltages within a predetermined range are desired.

It has been proposed to provide a plurality of voltages for electronic equipment by dividing a relatively large voltage with dividers of the variable resistance type. While such dividers are quite suitable for certain applications, the output voltage obtained from any resistance type divider is dependent on the current drawn through the voltage dropping portion of the divider. This feature makes resistance dividers unsuitable in many applications where variations in load current may apply.

Accordingly, it is an object of the present invention to provide an improved variable voltage switching device.

It is another object of the present invention to provide an improved variable voltage switching device comprising, in combination, a plurality of switching assemblies interconnected with taps on a multi-winding transformer in a manner whereby voltages may be added and subtracted to provide a continuous range of output voltages.

A further object of the present invention is to provide an improved variable voltage switching device that is relatively simple in construction and operation, and highly efficient in use.

These objects and related advantages of the present invention are attained in a variable voltage switching device comprising a multi-winding transformer and a plurality of switches in a novel circuit therewith. The transformer comprises a primary winding and at least two secondary windings. Two switching assemblies, each having a plurality of fixed contacts, a common contact, and means to connect one of the fixed contacts to the common contact selectively, are associated with each secondary winding. Two sets of fixed contacts of a pair of switching assemblies are connected in parallel with taps on each secondary winding. By connecting a common contact of each pair of switching assemblies associated with each of the secondary windings to each other, output voltages may be obtained between the remaining common contacts of the switching assemblies. Also, by dividing each of the secondary windings into sections of a predetermined turns ratio, it is possible to get a continuous range of output voltages, in equal steps, by algebraically adding the voltages of the secondary windings in phase or out of phase.

The novel features of the present invention, as well as the invention itself, both as to its organization and method of operation, will be understood in detail from the following description when considered in connection with the accompanying drawing which is a schematic diagram of a variable voltage switching device in accordance with the present invention.

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Referring now to the drawing, there is shown a variable voltage switching device 10 comprising a transformer having a primary winding 12 and at least two secondary windings 14 and 16. The primary winding 12 and the secondary windings 14 and 16 are wound around an iron core 18 in the same direction, as indicated by the dots adjacent to these windings. The ends of the primary winding 12 are connected to a pair of input terminals 20 and 22 for applying a suitable source of alternating current (A.-C.) voltage thereto. It will now be understood that the secondary windings 14 and 16 are inductively coupled to the primary winding 12, and that the voltages appearing across these secondary windings will be a function of the ratio of their turns to the turns of the primary 12.

Means are provided to divide each of the primary windings 14 and 16 into a plurality of sections of a predetermined turns ratio. To this end, taps 24, 26, 28, 30, 32, and 34 on the secondary winding 16 divide this winding into sections 25, 27, 29, 31, and 33 having a turns ratio of 1:2:3:4:1 with respect to each other.

By choosing the proper ratio of turns of the secondary 16 to the primary 12, the voltages across the sections 25, 27, 29, 31, and 33 of the secondary winding 16 may be 10 v., 20 v., 30 v., 40 v., and 10 v.

The secondary winding 14 may be divided, in a manner similar to that of the secondary 16, into sections 37, 39, 41, 43, and 45 by means of taps 36, 38, 40, 42, 44, and 46. The turns ratio of the sections 37, 39, 41, 43, and 45 is also 1:2:3:4:1 with respect to each other.

In the example illustrated by the drawing, the voltages across the sections 37, 39, 41, 43, and 45 of the secondary winding 14 are 0.5 v., 1.0 v., 1.5 v., 2.0 v., and 0.5 v., respectively. Thus, it will be understood that the secondary windings 14 and 16 are divided into sections having a similar turns ratio with respect to each other in each winding, but the turns of each of the sections of the secondary winding 16 are an integral multiple of the turns of corresponding sections of the primary winding 14. In the example illustrated in the drawing, the turns ratio of corresponding sections of the secondary windings 16 and 14 is 20:1.

A pair of switching assemblies, hereinafter called switches, is connected to each secondary winding. The switches may be similar and each switch is disclosed, for the sake of circuit simplicity, as the usual rotary type of switch having a series of stationary contacts numbered in order from 1 to 6. A movable switch arm 8 on each switch engages the stationary contacts. The contact 7 is common to the contacts 1 to 6 since the arm 8 can engage these contacts selectively. The switches are interconnected in a manner so that the voltage across one or more sections in one secondary winding may be added in phase or out of phase, selectively, to the voltage across one or more sections of the other secondary winding to provide a desired output voltage. Thus, a pair of switches S1 and S2 are associated with the secondary winding 16, and a pair of switches S3 and S4 are associated with the secondary winding 14.

A set of fixed contacts 1, 2, 3, 4, 5, and 6 of the switch S1 is connected in parallel with a set of fixed contacts 1, 2, 3, 4, 5, and 6 of the switch S2 and with the taps 24 and 26, 28, 30, 32, and 34 of the secondary winding 16. In a similar manner, a set of fixed contacts 1, 2, 3, 4, 5 and 6 of the switch S3 is connected in parallel with a set of fixed contacts 1, 2, 3, 4, 5, and 6 of the switch S4 and with taps 36, 38, 40, 42, 44, and 46 on the secondary winding 14. A common contact 7 of the switch S1 is connected to the common contact 7 of the switch S3. The common contacts 7 of the switches S2 and S4 are connected to a pair of output terminals 48 and 50, respectively. Each of the switches S1, S2, S3, and S4 has a

contact selecting means 8 to connect one of the fixed contacts 1, 2, 3, 4, 5 and 6 to its associated common contact 7, selectively.

The operation of the variable voltage switching device 10 will now be described. Let it be assumed that a suitable source of A.-C. voltage is applied to the input terminals 20 and 22 of the primary winding 12, and the transformed voltages previously mentioned, and illustrated in the drawing, appear across the sections 25—33 and 37—45 of the secondary windings 16 and 14, respectively. The variable voltage switching device 10 is capable of providing, in steps of 0.5 v., voltages from 0.5 v. to 115.5 v. between the output terminals 48 and 50. This is accomplished by adding or subtracting the voltage across one or more sections of one secondary winding and the voltage across one or more sections of the other secondary winding. With the switching arrangement of the present invention it is also possible to use the voltage of one or more sections of a single secondary winding.

Let it be desired, for example, to provide 0.0 v. between the output terminals 48 and 50. Each of the contact selecting means 8 of the switches S1, S2, S3, and S4 is moved to its respective contact 1. The voltage between the output terminals 48 and 50 will now be 0.0 v.

If 10 v. are desired between the output terminals 48 and 50, each of the contact selecting means 8 of switches S3 and S4 is placed on its respective fixed contact 1; the contact selecting means 8 of switch S1 is connected with its fixed contact 1; and the contact selecting means 8 of switch S2 is connected to its fixed contact 2. In this example, it is noted that the voltage across one section 25 of the secondary winding 16 is used, and no voltages of the sections of the secondary winding 14 are used.

Let it be desired to obtain an output voltage of 53.5 v. between the output terminals 48 and 50. The contact selecting means 8 of the switch S4 is connected to its corresponding fixed contact 3; the contact selecting means 8 of switch S3 is connected to its corresponding fixed contact 5; the contact selecting means 8 of switch S1 is connected to its corresponding fixed contact 2; and the contact selecting means 8 of switch S2 is connected with its corresponding fixed contact 4. This is the example illustrated by the positions of the contact selecting means 8 of the switches S1, S2, S3, and S4 shown in the drawing. In this case it will be noted that 50 v. across the sections 27 and 29 of the secondary winding 16 are added to 3.5 v. across the sections 41 and 43 of the secondary winding 14.

If 46.5 v. are desired between the output terminals 48 and 50, this voltage may be obtained by subtracting 3.5 v. from 50 v. This is obtained by connecting the contact selecting means 8 of switch S4 to its associated fixed contact 5; the contact selecting means 8 of switch S3 is connected to its associated fixed contact 3; the contact selecting means 8 of switch S1 is connected to its associated fixed contact 2; and the contact selecting means 8 of switch S2 is connected with its associated fixed contact 4. The output voltage between the output terminals 48 and 50 will now be 46.5 v. It will be noted that this example differs from the previous one in that the contact selecting means 8 of the switches S3 and S4 have been reversed. By this reversal, the phase of the voltage across the sections 41 and 43 of the secondary winding 14 is reversed with respect to the voltage across the sections 27 and 29 of the secondary winding 16. This provides the algebraic sum of the two voltages, in out of phase relationship. This is, in effect, a subtraction of the two voltages.

Let it be desired now to obtain a voltage of 85.5 v. between the output terminals 48 and 50. The contact selecting means 8 of switch S4 is placed in contact with its associated fixed contact 1; the contact selecting means 8 of switch S3 is placed in contact with its associated fixed contact 6; the contact selecting means 8 of switch S1 is placed in contact with its associated fixed contact 3; and the contact selecting means 8 of switch S2 is placed in contact with its associated fixed contact 6. The output

voltage is now 85.5 v. This is equal to the algebraic sum of similarly phased voltages. It will be noted that to obtain this output voltage, as a part of a continuous range of output voltages, the turns ratio of the sections of each of the secondary windings 14 and 16 has to be 1:2:3:4:1.

It will be obvious that the example of voltages shown and described are merely illustrative, and are by no means to be considered in a limiting sense.

While the switches S1, S2, S3, and S4 have been shown as rotary type switches, it will be understood that any switching assemblies wherein any one of a plurality of contacts may be connected to a common contact, selectively, may be used within the scope of the present invention.

15 What is claimed is:

1. Means for obtaining a voltage of predetermined amplitude comprising at least two separate sources of alternating current voltage, each of said sources bearing a predetermined phase relationship with respect to the other and being divided into voltages of lesser amplitude, a plurality of switches each comprising a plurality of fixed contacts, a common contact, and means to connect said common contact selectively with a predetermined one of said fixed contacts, a pair of said switches having their corresponding fixed contacts connected to each other in parallel and to a separate voltage point in each of said voltage sources, respectively, means connecting one of said common contacts in one of said pair of switches directly to another common contact in another pair of switches, and output means connected directly to remaining common contacts of said one and said other pairs of switches.

2. A device for obtaining selected alternating current voltages comprising a plurality of alternating current voltage sources, each of said sources having the same instantaneous polarity, a pair of switches associated with each source, each of said pairs of switches having corresponding fixed contacts thereof connected in parallel with each other and with separate connections to intermediate voltage points on its associated voltage source, each switch having a common contact and means to connect said common contact with a selected one of said fixed contacts, corresponding common contacts of one switch of each pair being directly interconnected, output terminals, and the remaining common contacts of each pair being connected directly to said output terminals.

3. A variable voltage switching device comprising a transformer having a primary winding and at least two secondary windings, a plurality of taps on each of said secondary windings, a separate pair of sets of contacts connected in parallel with each of said taps in each of said secondary windings, a separate common contact associated with each of said sets of contacts, means connecting two of said common contacts associated with separate pairs of sets of contacts directly to each other, output means connected directly to the remaining common contacts associated with said separate pairs of sets of contacts, and means connecting each of said common contacts selectively with a separate one of said contacts in each of its associated set of contacts, whereby induced voltages in one of said secondary windings may be added algebraically to induced voltages in the other of said secondary windings.

4. A variable voltage switching device comprising a transformer having a primary winding and at least two secondary windings, a plurality of taps on each of said secondary windings, a separate pair of sets of contacts connected in parallel with each of said taps in each of said secondary windings, a separate common contact associated with each of said sets of contacts, means connecting two of said common contacts associated with separate pairs of sets of contacts directly to each other, output means connected directly to the remaining common contacts associated with said separate pairs of sets of contacts, means connecting each of said common

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contacts selectively with a separate one of said contacts in each of its associated set of contacts whereby induced voltages in one of said secondary windings may be added or subtracted to induced voltages in the other of said secondary windings, and said taps on at least one of said secondary windings dividing said one secondary winding into sections having a turns ratio of 1:2:3:4:1, respectively.

5. A variable voltage switching device comprising a transformer having a primary winding and at least two secondary windings, means to apply an A.-C. voltage to said primary winding, a plurality of taps on each of said secondary windings, at least four switching assemblies each having a plurality of fixed contacts, a common contact, and means for selectively connecting one of said fixed contacts to said common contact, means connecting each of said taps in one of said secondary windings to a separate fixed contact in each of a first pair of said switching assemblies, means connecting each of said taps in another of said secondary windings to a separate fixed contact in each of a second pair of said switching assemblies, means connecting one of said common contacts in said first pair of switching assemblies directly to one of said common contacts in said second pair of switching assemblies, and output means connected directly to the other common contacts in each of said first and second pairs of switching assemblies.

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6. A variable voltage switching device comprising a transformer having a primary winding and at least two secondary windings, means to apply an A.-C. voltage to said primary winding, a plurality of taps on each of said secondary windings, at least four switching assemblies each having a plurality of fixed contacts, a common contact, and means for selectively connecting one of said fixed contacts to said common contact, means connecting each of said taps in one of said secondary windings to a separate fixed contact in each of a first pair of said switching assemblies, means connecting each of said taps in another of said secondary windings to a separate fixed contact in each of a second pair of said switching assemblies, means connecting one of said common contacts in said first pair of switching assemblies directly to one of said common contacts in said second pair of switching assemblies, output means connected directly to the other common contacts in each of said first and second pairs of switching assemblies, and said taps on at least one of said secondary windings dividing it into sections having a turns ratio of 1:2:3:4:1, respectively, with respect to each other.

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